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EP 0566874 A2 EP 0497083 A1 WO 96/24789 A2
US 5528668 A

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(54) Cellular Radio Communication System Architecture

(57) A cellular radio communication system includes base transceiver stations each of which communicates with one or more mobile stations. A central cell system control station to which the base transceiver stations are linked is adapted to carry out at least some of those signal processing operations relating to the establishment of a link between one mobile station and another or a telephone system. Such signal processing operations normally carried out in a base transceiver station include coding/decoding and channel allocation.

The base transceiver stations are thereby smaller and cheaper to build and install.

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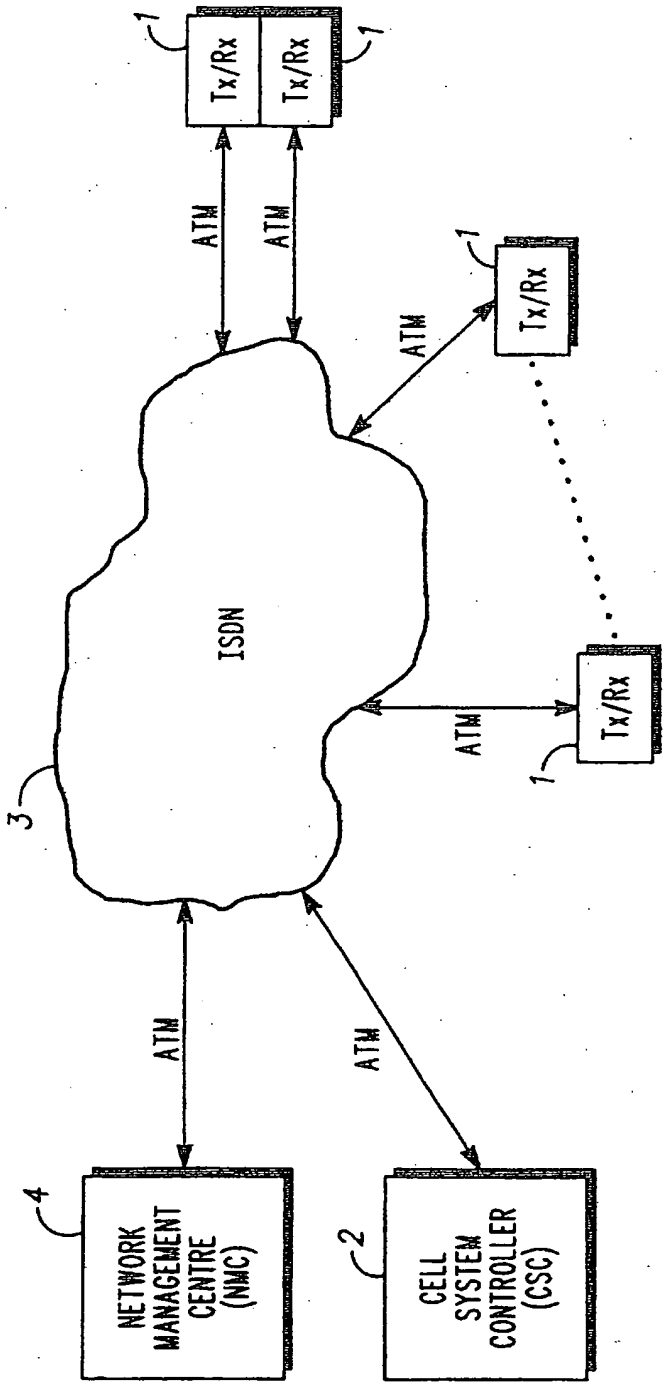
At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.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ISDN
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NETWORK MANAGEMENT CENTRE (NMC)
4
CELL SYSTEM CONTROLLER (CSC)
2

FIG.1

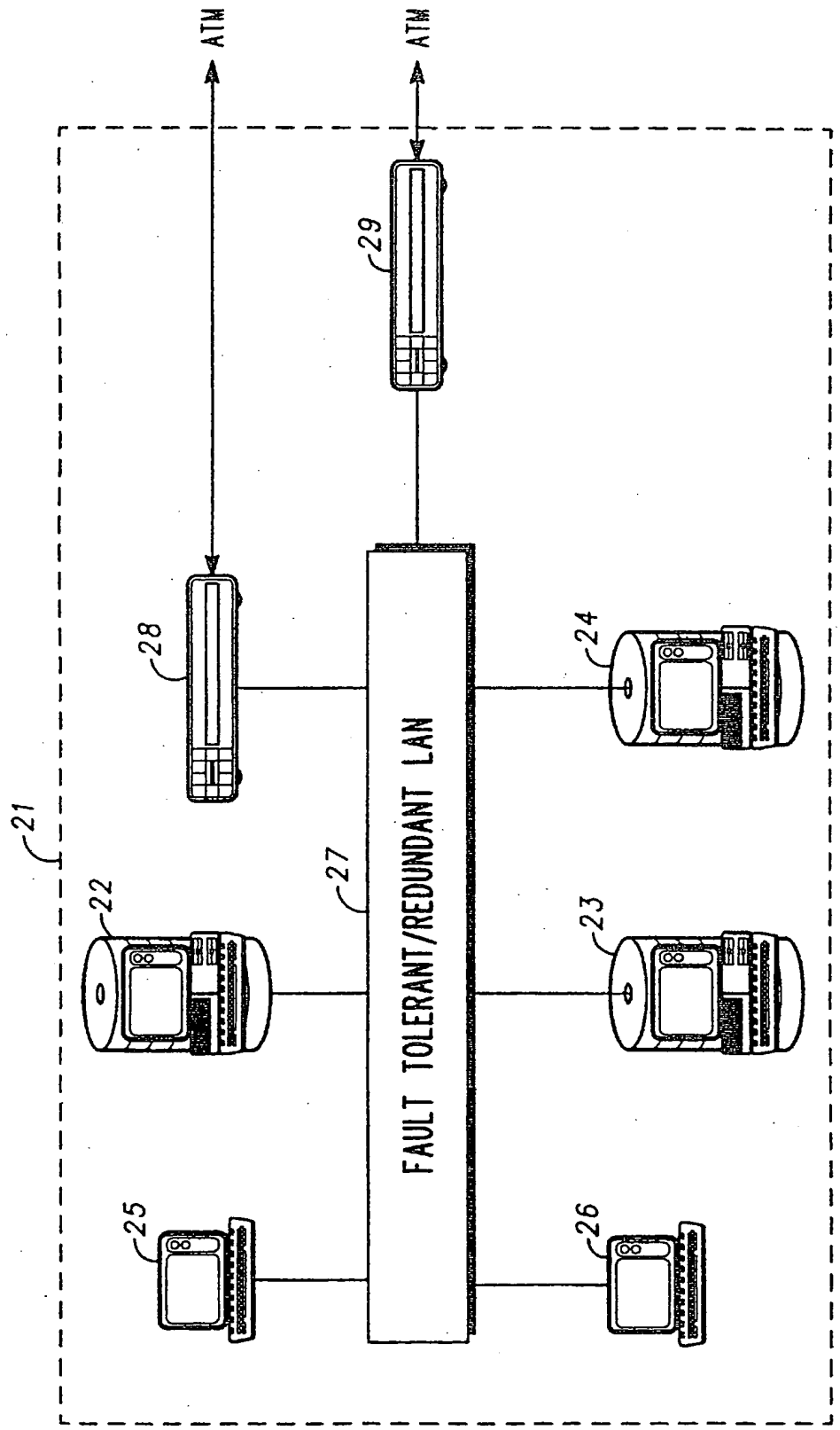

FIG. 2

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A CELLULAR RADIO COMMUNICATION SYSTEM ARCHITECTURE

Field of the Invention

The present invention relates to the arrangement of the components of a cellular radio communication system, hereinafter referred to as the architecture of a system.

Background of the Invention

Cellular radio communication systems have an hierarchical structure - each cell of a given system has a base transceiver station which communicates with one or more mobile transceiver stations within its associated cell. The base transceiver stations of a number of cells are linked, usually by land line with a co-ordinating station, which in its turn is linked with a switching station which connects one region of the cellular radio communication system with another, or another cellular radio communication system via the telephone network.

In cellular radio communication systems which conform with specifications laid down by a body known as Group Systems Mobile (GSM Systems) there are four such components in the hierarchy. These are:

1. A base transceiver station (BTS) which communicates directly with one or more mobile stations in a cell.

2. A base site controller (BSS) which co-ordinates the actions of a number of base transceiver stations, and hence cells, in a region of the system.

3. A remote transcoder station (R x CDR) which carries out the coding and decoding of speech into the digital format used by GSM systems, and

4. Mobile switching centres which interface the regions of the system controlled by each base site controller with one another and other systems via the telephone network.

One or more of these can be combined physically, for example, the base transceiver station can carry out the function of a base site controller to provide a Base Station Subsystem (BSS).

Cellular radio communication systems are classified according to the nominal radii of the cells concerned, those having radii greater than 3 km having the designation "macro", those having radii between 1 and 3 km having the designation "micro", those having radii between 100 metres and 1 km having the designation "pico" and those being radii less than 100 metres having the designation "personal".

Market pressures require ever smaller base transceiver stations, particularly in the case of the smaller cell systems, where the number of base transceiver stations required in a given area will be large. Micro and smaller cells usually operate in built-up areas and their base transceiver stations are attached to buildings or other structures and need to be as small as possible, both to reduce their visual impact and to reduce rental charges for the space required to install them.

Summary of the Invention

It is an object of the present invention to provide an improved architecture for a cellular radio system.

According to the invention there is provided a cellular radio communication system including a plurality of base transceiver stations each of which communicates with one or more mobile stations within a respective cell of the cellular radio communication system, wherein there is provided a central cell system control station to which the base transceiver stations are linked and which is adapted to carry out at least some of those signal processing operations relating to the establishment of a link between one mobile station and another or a telephone system which normally are carried out in a base transceiver station.

Preferably the base transceiver stations retain the function of channel equalisation in the receiving mode so that high quality signals are supplied by the base transceiver stations to the central system control station.

Channel coding/decoding, however, is transferred to the cell system controller. These functions normally are associated with particular carrier units and are located close to the final RF transceiver stages of a base transceiver station. Hence in a conventional cellular radio communication system each base transceiver station RF stage has a number of signal processing devices associated with it, which are a major factor in determining the size and capital cost of the base transceiver station. By carrying out the coding/decoding operations centrally, these signal processors can be eliminated, so reducing the size and capital cost of base transceiver stations.

Other base transceiver functions also can be carried out by the cell system control station, as can speech transcoding and the control and interfacing functions of base site controller and mobile switching centres.

Brief Description of the Drawings

The invention will now be described by way of example, with reference to the accompanying drawings in which,

FIG. 1 is a schematic representation of an embodiment of the invention, and

FIG. 2 is a schematic representation of a central system control station for use in carrying out the invention.

Description of a Preferred Embodiment

Referring to FIG. 1 a cellular radio communication system embodying the invention consists of a number of base transceiver stations 1 each of which is connected to a central cell system controller 2 via a telecommunications network 3. The cell system controller 2 is linked with a network management centre 4 via the telecommunication network 3. The network management centre 4 is conventional in its mode of operation and will not be described further.

The cell system controller 3, on the other hand, is arranged to have the signal processing capabilities to support a large number of base transceiver stations 1, performing the channel coding/decoding operations which usually are carried out in base transceiver stations, together with other base transceiver station functions, such as call routing to particular mobile stations. However, so that the traffic data signals supplied to the cell system controller 4 are of high quality, the base transceiver stations 1 retain the function of channel equalisation when operating in the receive mode. The base transceiver stations 1, therefore, are simple devices and much reduced in size compared with conventional base transceiver stations. This is very advantageous in the context of micro cellular systems, where the RF power output required is low and the non-RF components of a base transceiver station form a major proportion of the physical structure of the base transceiver station. Also, because of the small sizes of micro cells, a larger number of base transceiver stations are required, so that the simplification of the base transceiver stations arising from the present invention represents a considerable lessening of the capital cost of a micro cellular radio communication system.

The cell system controller 4 also is adapted to carry out the functions of coding speech signals into the format required by the cellular radio communication system and vice versa. In the case of GSM systems, the cell system controller 4 also is adapted to carry out the functions of conventional base site controllers and mobile switching centres.

As the cell system controller 4 is controlling the operations of a large number of base transceiver stations 1 over an extensive geographical area, it has access to a much larger amount of information about the activity within the cellular radio communication system than does a conventional base site controller, and can be endowed with the facility to allocate resources accordingly. This is particularly relevant in situations where a number of micro cells operate within an umbrella macro cell (also under the control of the cell system controller) and a decision has to be made whether to hand over a mobile station from one macro cell to another or to the umbrella cell, or from the umbrella cell to a particular micro cell.

Because the cell system controller 4 is critical to the operation of the cellular radio communication system, precautions have to be taken against its possible failure. This can be done by building in a level of redundancy and/or using fault tolerant signal processing systems, together with the use of a modular form of construction. FIG. 2 shows schematically, a layout for a cell system controller suitable for use with a cellular radio communication system embodying the invention. Referring to FIG. 2, a cell system controller 21 consists of at least one call processing unit 22, and at least one signal processing unit 23, and at least one hard disk store 24 for code and network statistics, together with associated monitor units 25 and 26, all linked together via a fault tolerant local area network 27, which also has a level of redundancy built into it. The local area network 27 is connected to the telecommunication network 3 via multiple interface units 28 and 29.

For this system to operate effectively, it is necessary that the links between the base transceiver stations 1 and the cell system controller 4 should enable the following criteria to be satisfied.

1. Once a link between a base transceiver station 1, the cell system controller 4 and a second base transceiver station, the signal transit time should be constant.

2. In a digital cellular radio communication system, the bit rate should be scaleable that is, the base transceivers 1 and the cell system controller 4 should have the capacity for varying the bit rate fed into the

telecommunication network 3 according to the traffic requirements of the cellular radio communication system, and

3. The interface points between the base transceiver stations 1 and the telecommunications network 3 must be readily available.

The first two criteria apply also to the local area network 27 in the cell system controller 4.

The first two criteria can be met by the use of the interfacing technique as ATM (Asynchronous Transfer Mode) or any other equally sufficient technique that is known in the art.

Claims

1. A cellular radio communication system including a plurality of base transceiver stations each of which communicates with one or more mobile stations with a respective cell of the cellular radio communication system, wherein there is provided a central cell system control station to which the base transceiver stations are linked and which is adapted to carry out at least some of those signal processing operations relating to the establishment of a link between one mobile station and another or a telephone system which normally are carried out in a base transceiver station.

2. A system according to Claim 1 wherein the base transceiver stations are adapted to carry out the operation of channel equalisation when operating in the receive mode.

3. A system according to Claim 1 or Claim 2 wherein the cell system control station is adapted to carry out the operations of speech coding/decoding as required by the cellular radio communication system.

4. A system according to any of Claims 1 to 3 wherein the cell system control station is adapted to carry out the operations of channel coding/decoding for each of the base transceiver stations associated with the cellular radio communications system.

5. A system according to Claim 4 wherein the signal processing capability of the cell system control station available for channel coding/decoding can be varied.

6. A system according to any preceding claim wherein the cell system control station is adapted to monitor the level of activity of the base transceiver stations linked to it and allocate resources accordingly.

7. A system according to any preceding claim wherein the cell system controller is modular in construction.

8. A system according to Claim 7 wherein the cell system controller comprises a plurality of fault tolerant processing units linked by a fault tolerant local area network.

9. A system according to any preceding claim wherein the base transceiver stations and the cell system control station are linked by a telecommunications network in such a manner that the signal transit time from one base transceiver station to another once contact is established is constant and the rate at which the base transceiver stations and cell system control station feed digital data bits into the telecommunication network is a function of the traffic load within the system.

10. A system according to Claim 9 wherein the base transceiver stations and the cell system controller are linked to the telecommunications network by the technique known as asynchronous transfer mode.

11. A cellular radio communication system substantially as herein before described and with reference to the accompany drawings.

The Patent Office

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Application No: GB 9626563.2 **Examiner:** Nigel Hall
Claims searched: all **Date of search:** 5 March 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H4L (LDSX, LECX)

Int Cl (Ed.6): H04Q 7/22, 7/30; H04B 7/26

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	EP 0566874 A2	(SIEMENS) See abstract	1,9
X	EP 0497083 A1	(ERICCSON) See col 1 lines 25-27; fig. 2	1-5,9
X	WO 95/24789 A2	(NOKIA) See p.3, lines 13-17,23-27	1-5,9
X	US 5528668	(AIHARA) See col. 1 lines 32-35	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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